Capacity building in Smart and Innovative eNERGY management

SINERGY: Three living laboratories strengthening research capacity in smart energy management

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Sustainable Places 2023 – Madrid – 14th – 16th June 2023

SUSTAINABLE PLACES 2023

Capacity building in Smart and Innovative eNERGY management

Sinergy

Institute Mihajlo Pupin

Austrian Institute of Technology

University of Galway (formerly NUIG)

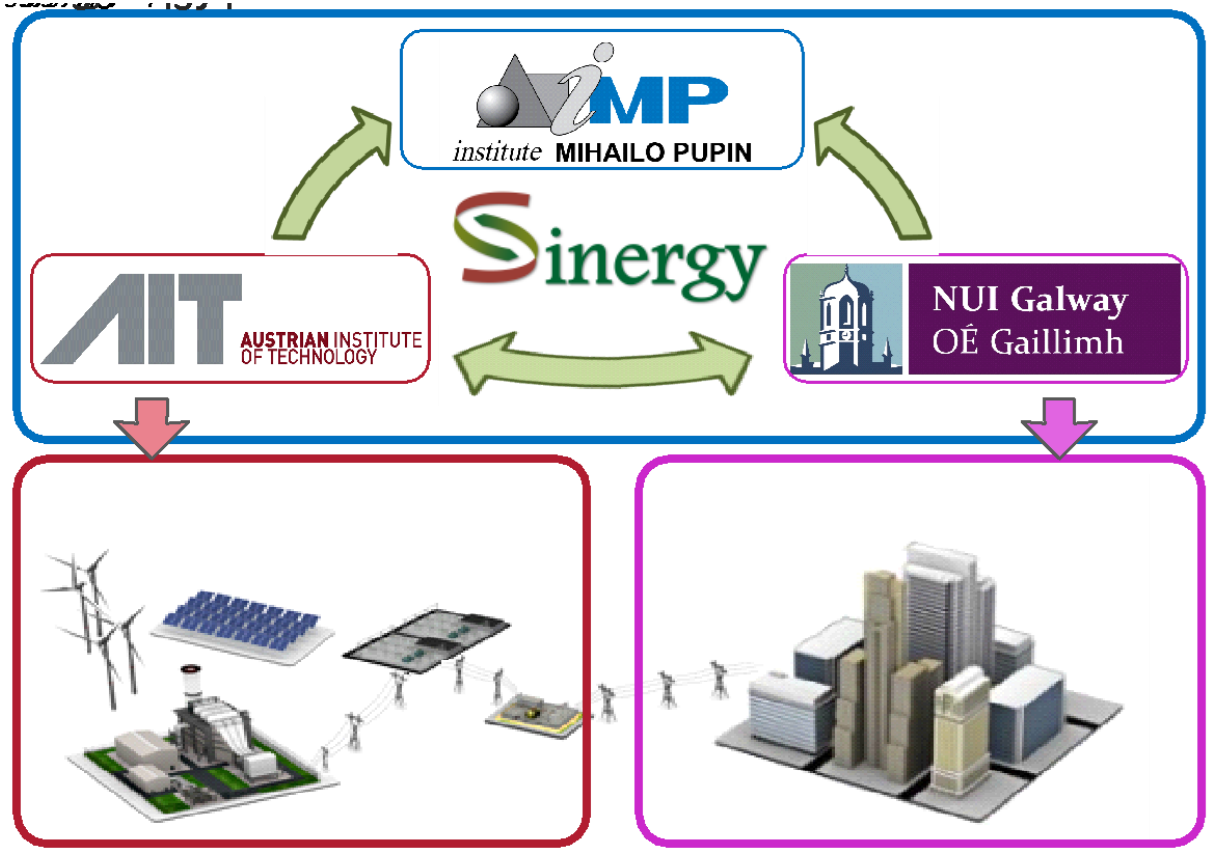
The SINERGY Project

- **Project lifetime:** Jan. 2021 – Dec. 2023
- **Partners**
  - IMP Institute Mihajlo Pupin, Serbia (**Coordinator**)
  - AIT Austrian Institute of Technology GMBH
  - University of Galway (formerly NUIG)
- **Long-term mission**
  - **Position the Institute Mihajlo Pupin (IMP) as one of the leading institutions in smart energy management** in Southeast Europe, capable of driving the region towards meeting the 21st century challenges in the Energy sector
  - **Unlock IMP's research potential** in domain of smart energy management and **integrate into European Research Area (ERA)**

This project has received funding from the H2020 programme of the European Union under GA No. 952140

Motivation & Vision

- **Strategic partnership and transfer of multidisciplinary "know-how"** from leading EU research institutions
- **Building research potential through the collaboration with the AIT and NUIG** in domain of advanced smart grids and building operation efficiency, covering both energy supply and demand side
- **Strengthen IMP's human resources, engage young researchers and enhance the networking channels** with eminent researchers from abroad
- **Establish knowledge and technology transfer platform** with necessary infrastructure and equipment



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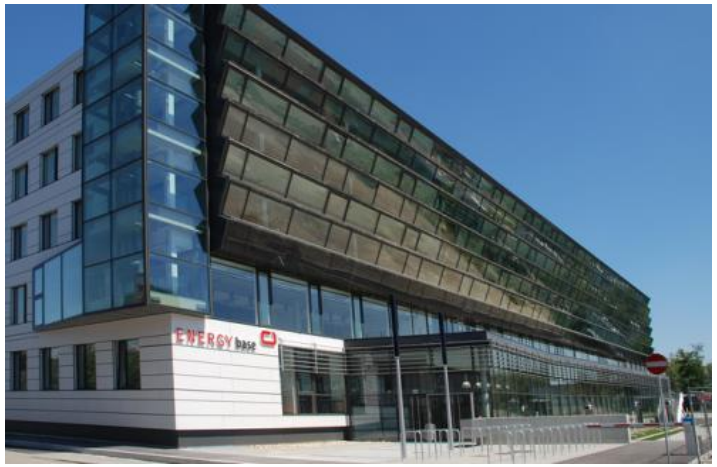
Knowledge & technology transfer platform

with necessary infrastructure and equipment

EnergyBase, TechBase (Vienna)



Alice Perry Engineering Building (Galway)

Institute Mihajlo Pupin (Belgrade)

SUSTAINABLE PLACES 2023

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IMP Pilot

Institut Mihailo Pupin. Belgrade. Serbia

ICT force behind your success …

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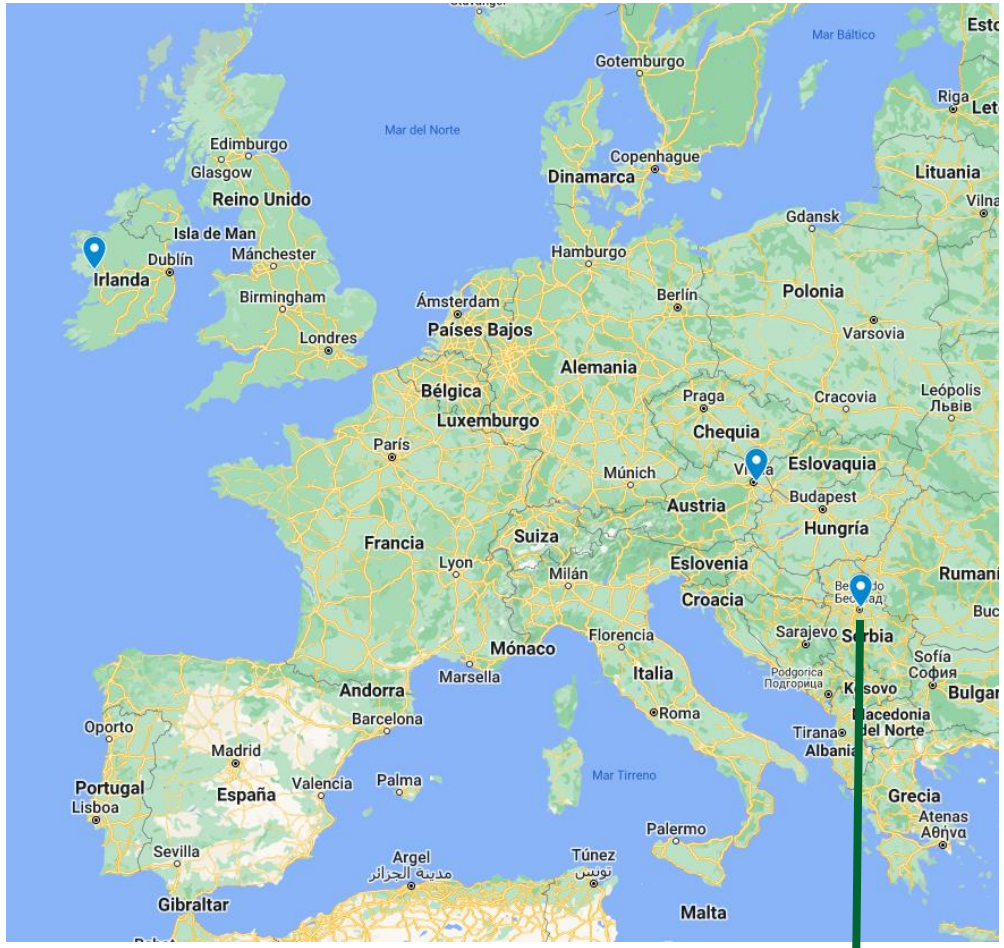
Volgina 15, 11060 Belgrade
Serbia, Europe. Postal address code: 141623



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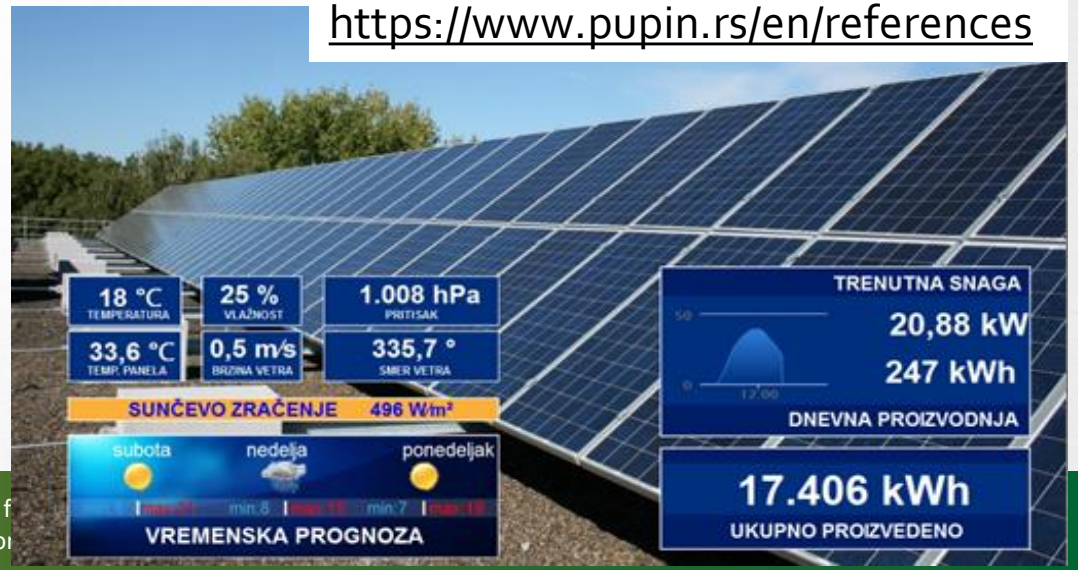
IMP Motivation & Vision

Regional Centre of Excellence in smart energy management

- Dispatching centers in Serbia
- Supervision of transmission network
- Supervision of entire distribution network
- Integrated monitoring and balancing the SMM block

Sinergy

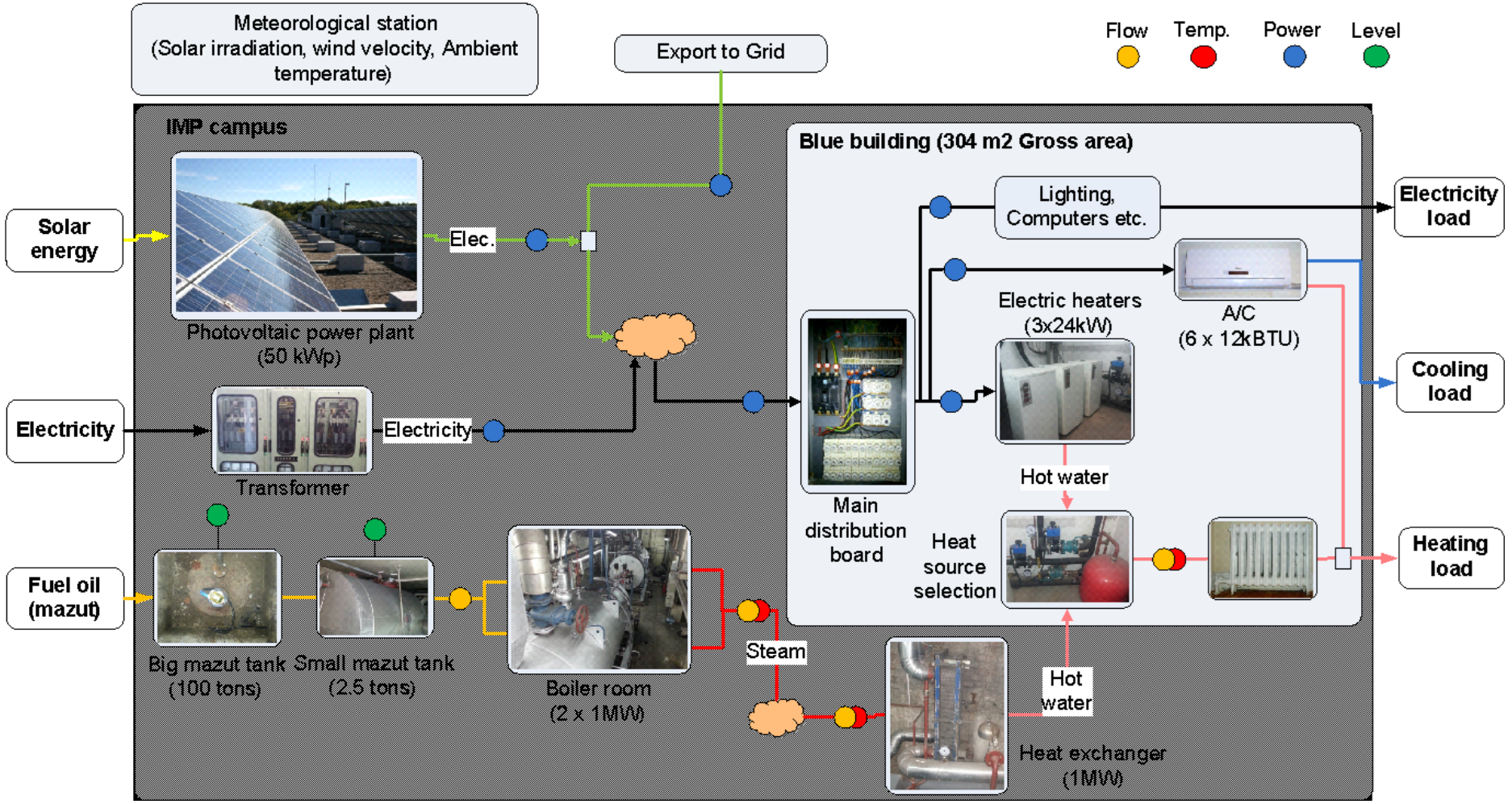
Commercial Projects,
https://www.pupin.rs/en/references



This project has received funding f
programme of the European Unio

IMP campus as a Testbed

- Building, with offices, meeting room and a testing facility
- Three heating alternatives
  - Heating plant – using radiators running on hot water
  - Electric boilers – using radiators running on hot water
  - A/C – using electricity to heat the surrounding air
- Heat and electricity dispatching infrastructure
- Manual or automated control (SCADA)



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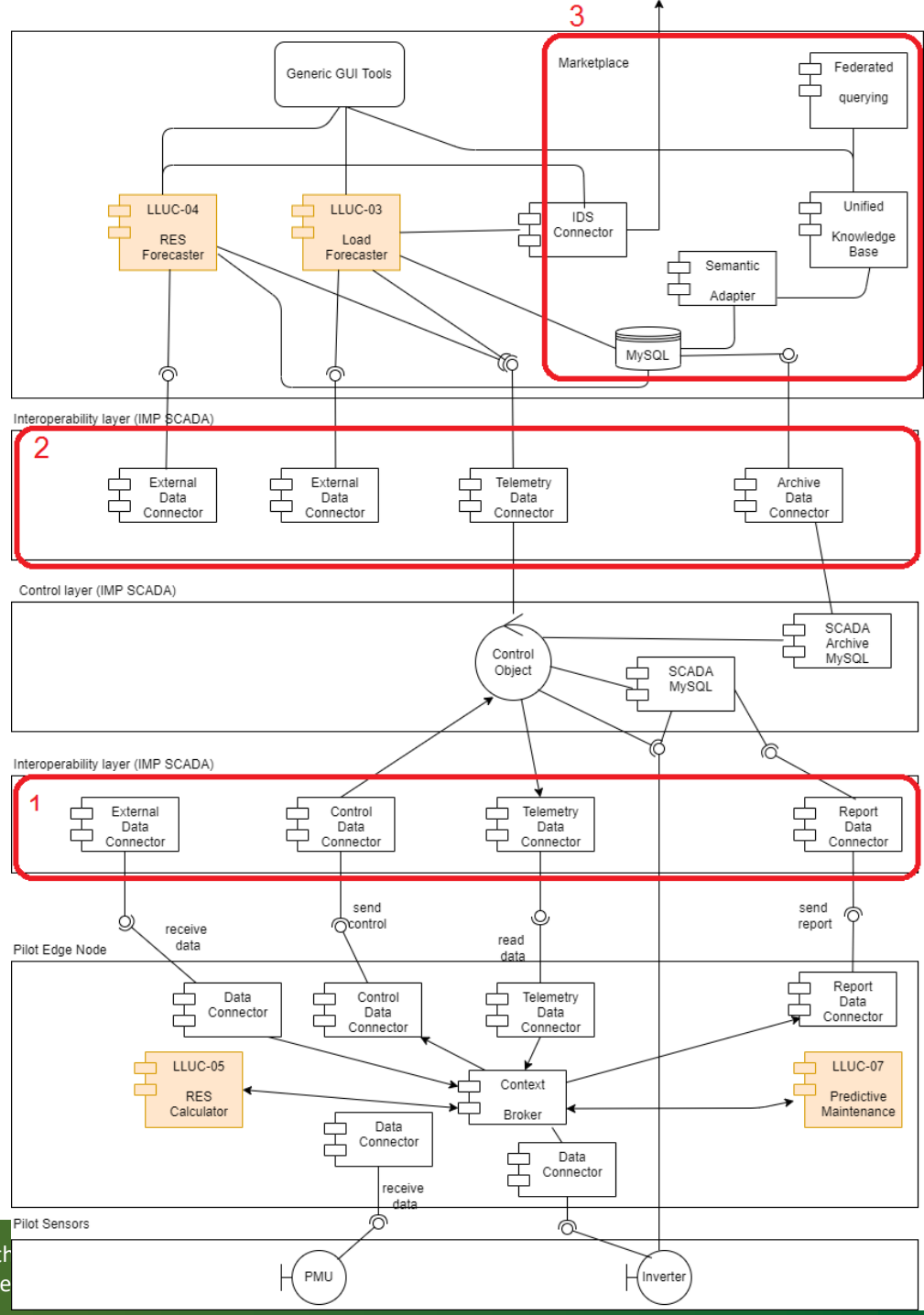
Edge vs Cloud Analytics

PV plant – modules P_n = 50kWp



This project has received funding from th
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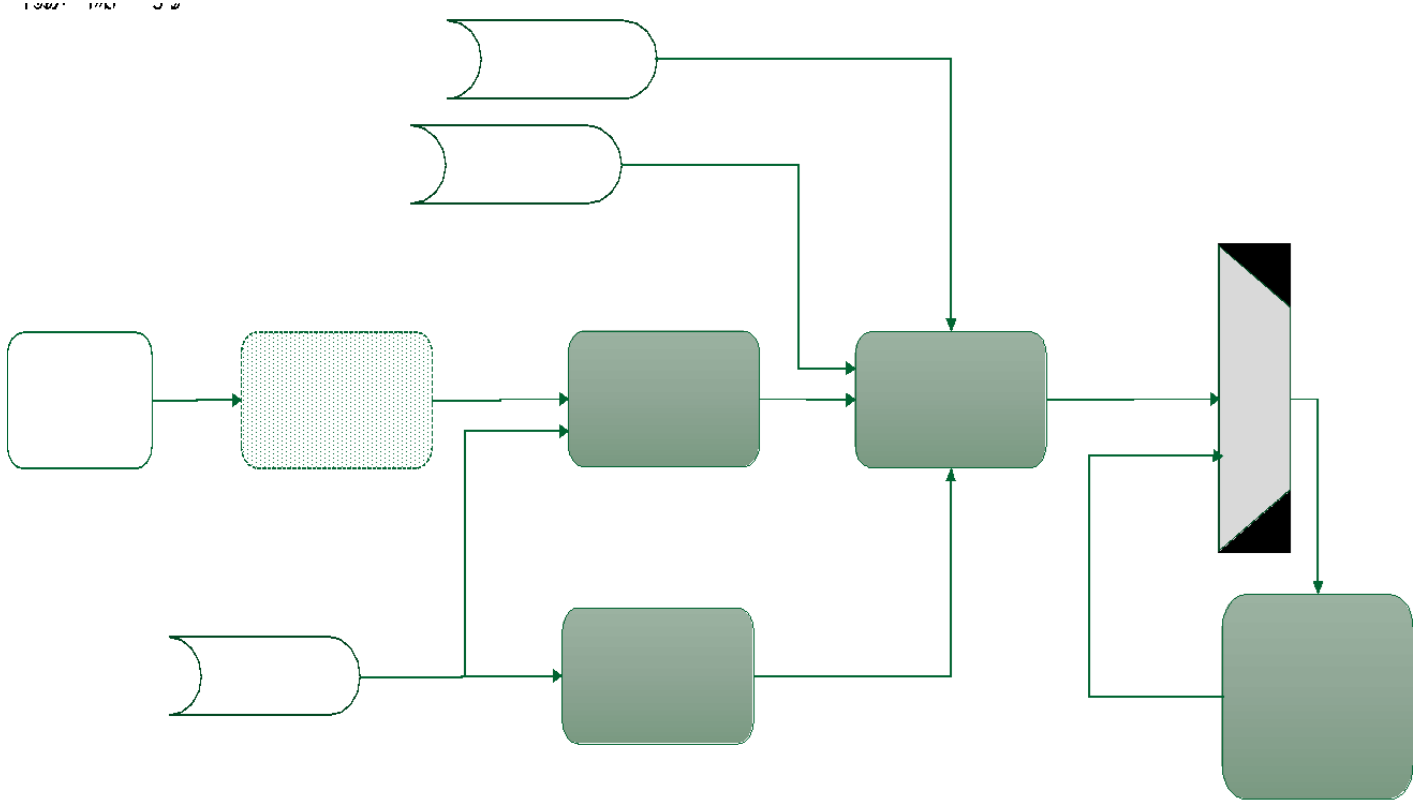
Energy services as Key Exploitable Results



› Stakeholders

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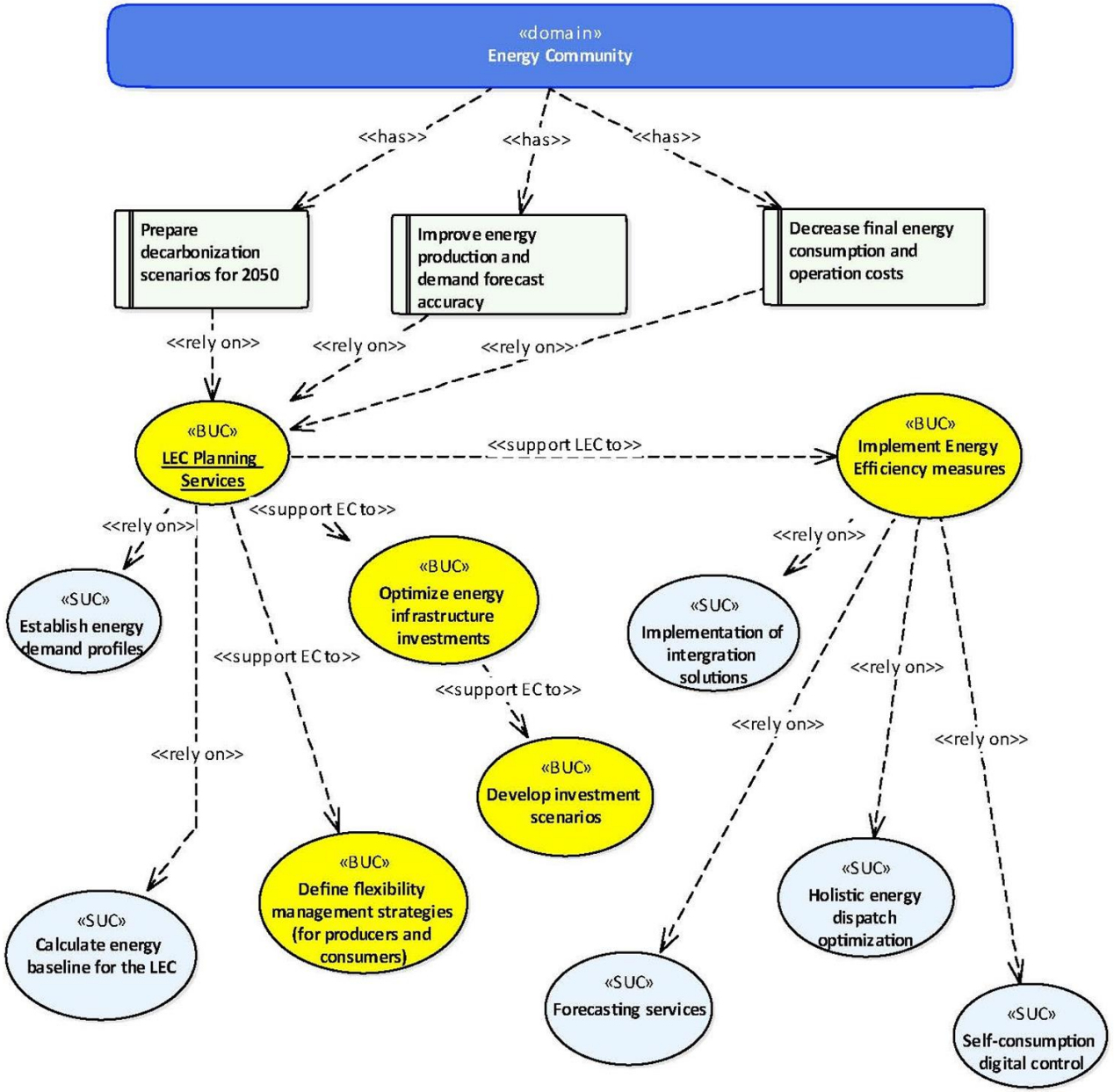
Energy Services Integration

- Planning services
- Non-intrusive load monitoring
- Local and aggregated energy demand/consumption prediction
- Renewable energy sources (RES) generation forecasting
- Energy dispatch optimisation
- Energy performance evaluation and benchmarking



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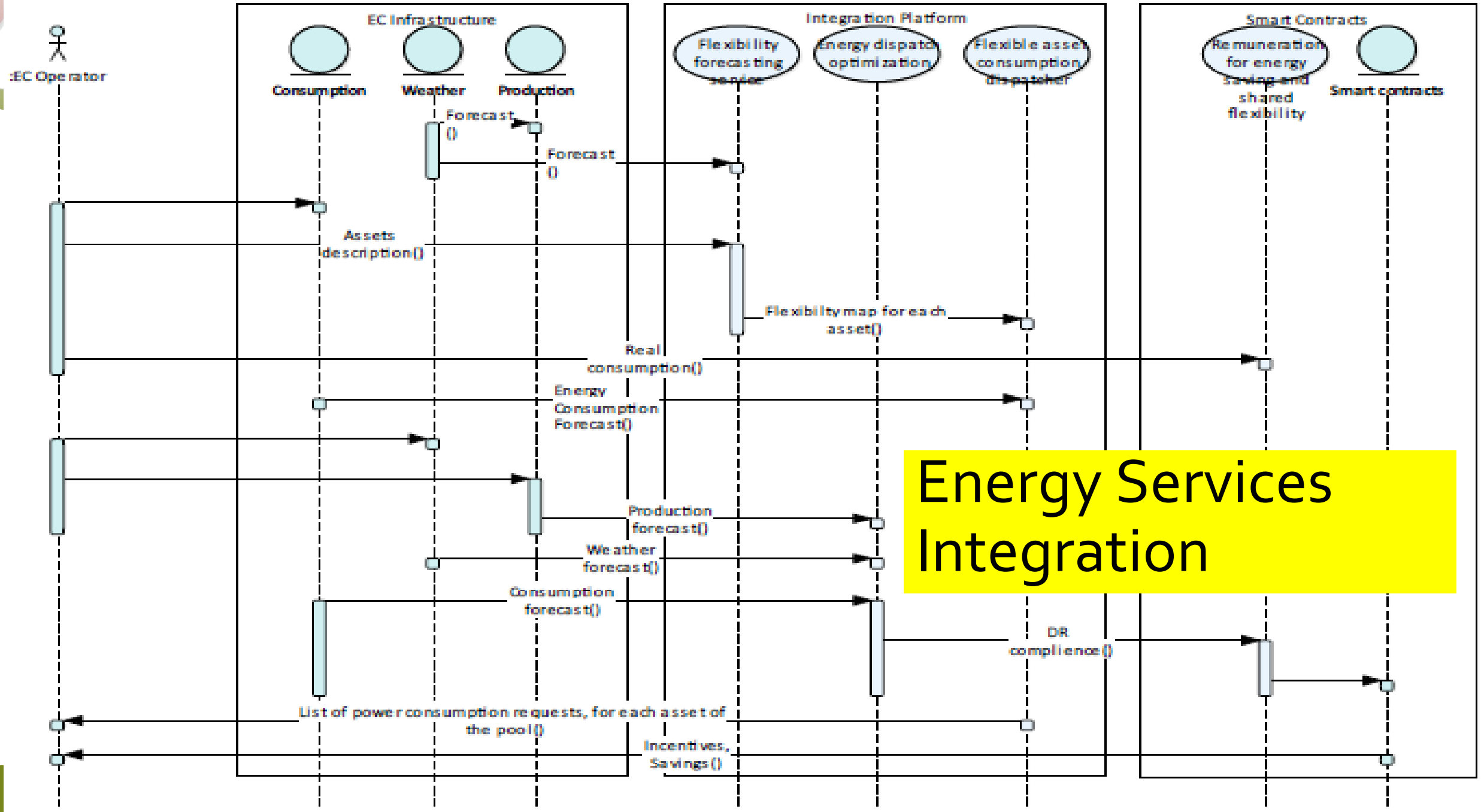
:EC Operator
EC Infrastructure
Consumption
Weather
Production
Integration Platform
Flexibility forecasting service
Energy dispatch optimization
Flexible asset consumption dispatcher
Smart Contracts
Remuneration for energy saving and shared flexibility
Smart contracts
Forecast ()
Forecast ()
Assets description()
Flexibility map for each asset()
Real consumption()
Energy Consumption Forecast()
Production forecast()
Weather forecast()
Consumption forecast()
DR compliance()
List of power consumption requests, for each asset of the pool()
Incentives, Savings()
Energy Services Integration

Running EU Projects

- **HESTIA: H**olistic d**E**mand response **S**ervices for European residen**TIA**l communities, GA No. 957823
- **REACT: R**enewable **E**nergy for self-sust**A**inable island **C**ommuni**T**ies, GA No. 824395
- **PLATOON**: Digital **PLA**tform and analytical **TOO**ls for e**N**ergy, GA No. 872592
- **TRINITY: TR**ansmission system enhancement of reg**IoN**al borders by means of **I**ntelligen**T** market technolog**Y,** GA No. 863874
- **NEON: N**ext-Generation Integrated **E**nergy Services f**O**r Citizen Energy Commu**N**ities, GA No. 101033700
- **OMEGA-X: O**rchestrating an interoperable sovereign federated **M**ulti-vector **E**nergy Data Space built on open standards and ready for **GA**ia-X, GA No. 101069287
- **FEDECOM: FEDE**rated -system of systems- approach for flexible and interoperable energy **COM**munities
- **R2D2: R**eliability, **R**esilience and **D**efense technology for the gri**D**

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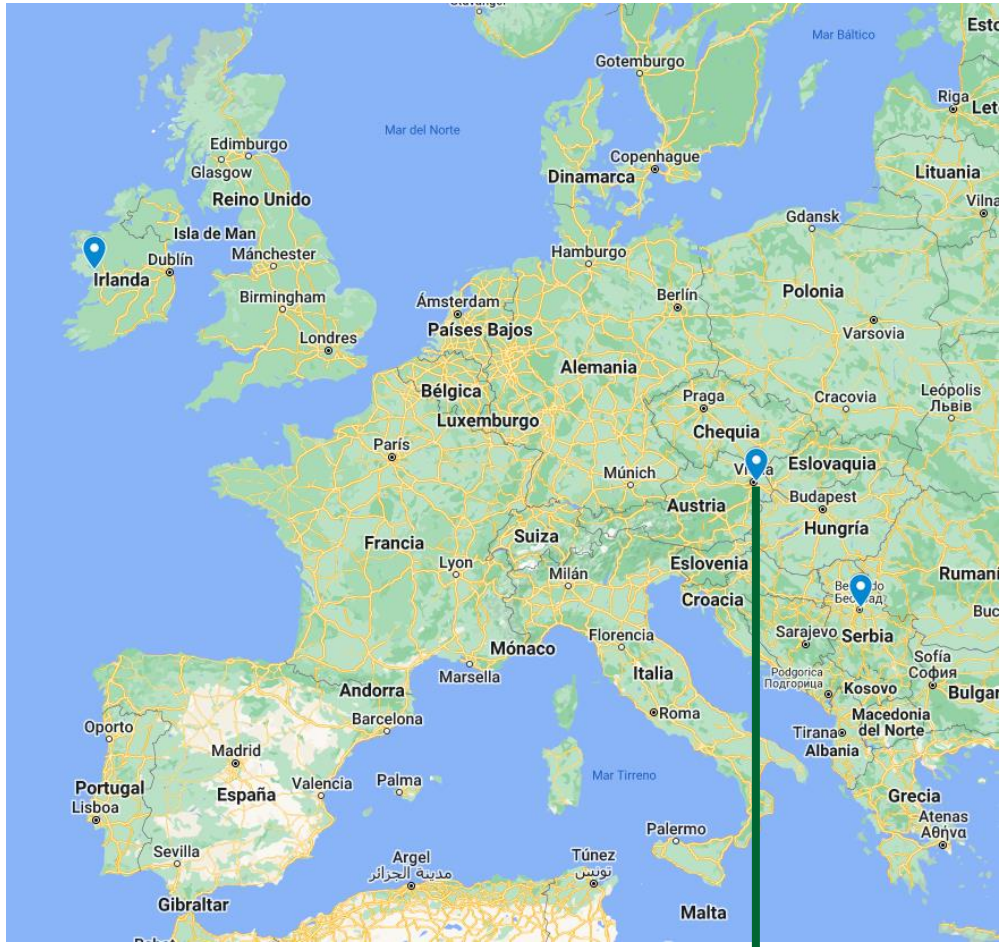
AIT Pilot

Institut Mihailo Pupin. Belgrade. Serbia

AIT: Tomorrow, today.

AIT Austrian Institute of Technology GmbH
Giefinggasse 4
1210 Vienna
Austria



AUSTRIAN INSTITUTE OF TECHNOLOGY

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AIT Austrian Institute of Technology Electric Laboratories

AUSTRIAN INSTITUTE OF TECHNOLOGY

High Power and High Voltage

150 kA/120M VA Short-circuit testing, arc analysis, 1.2 MV impuls testing, partial discharge measurements dielectric tests

Power Electronics and Low Inertia Systems

AC/DC converters, power-hardware-in-the-loop, real-time simulator, storage emulation, power electronics design and handling

SmartEST

Low voltage technologies, grids and system interaction, 1 MVA controllable sources, AC and DC sinks, real-time simulator, smart secondary substation

Inverter Testing in SmartEST

EVSE Testing

High Voltage Laboratory

Smart and Secure Secondary Substation

High Power Testing

Power Electronics Laboratory

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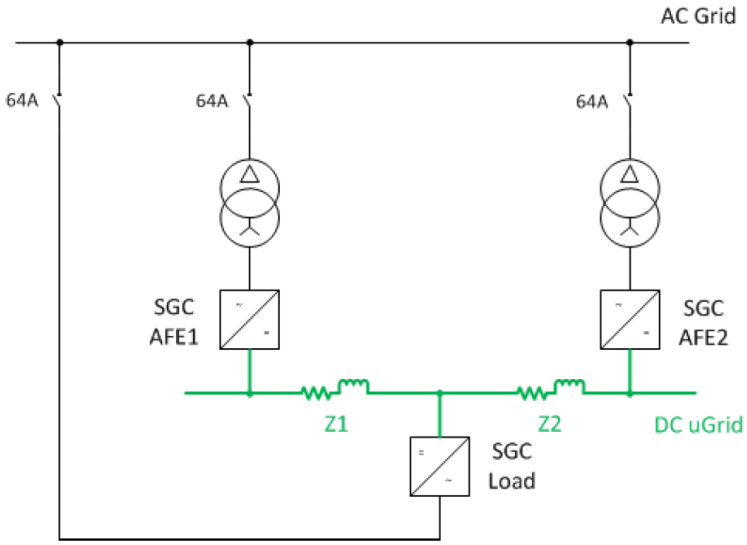
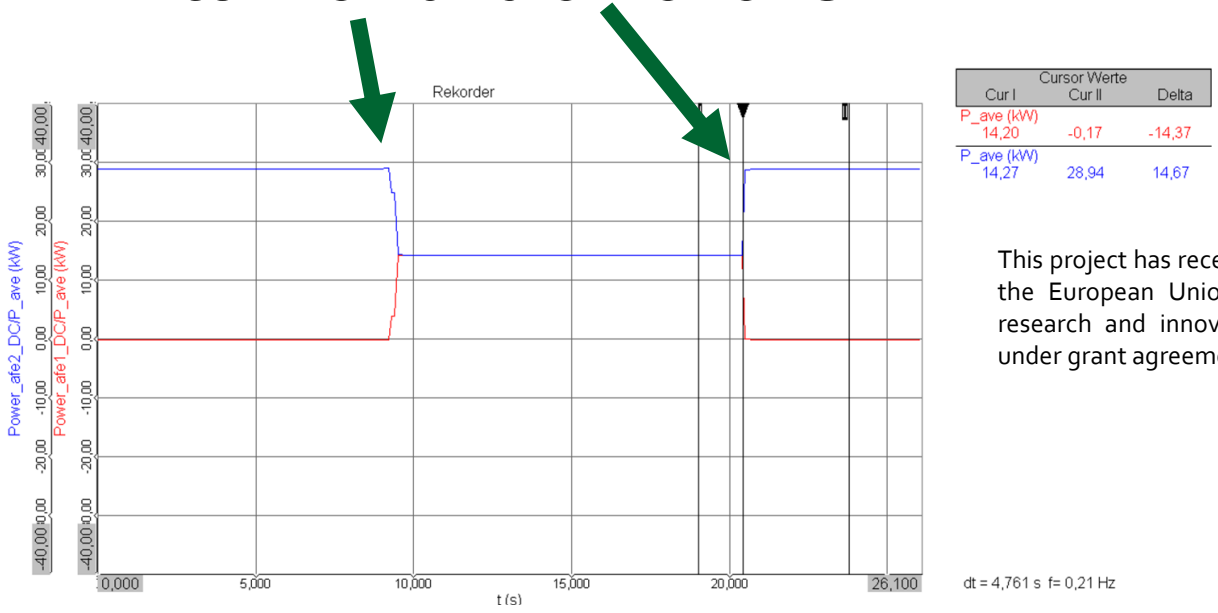
DC and Hybrid ACDC grids
Example 1: DC microgrid load sharing



Test time	Parameter	Change
t_0	$State_{AFE1}$	OFF
t_0	$State_{AFE2}$	ON
$t_1 \rightarrow t_2$	P_{AFE1}; P_{AFE2}	transient change
t_2	$State_{AFE1}$; $State_{AFE2}$	ON
$t_3 \rightarrow t_4$	P_{AFE1}; P_{AFE2}	transient change
t_4	$State_{AFE1}$	OFF
t_4	$State_{AFE2}$	ON

› Active Front End (AFE) for DC grid forming

 turn on and off of one AFE



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 957788

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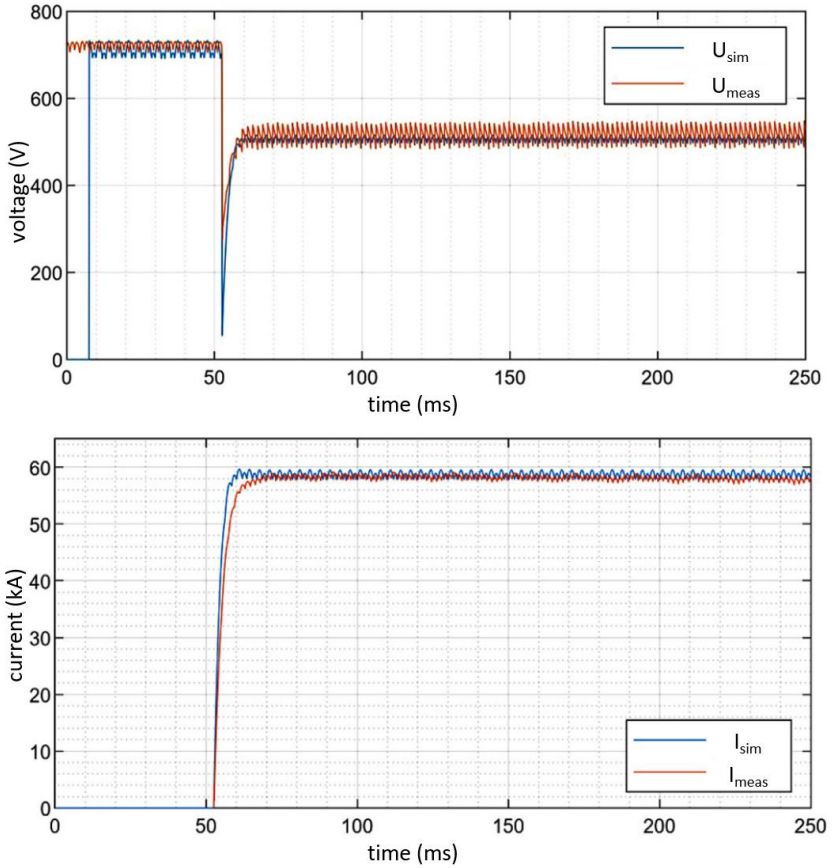
DC and Hybrid ACDC grids
Example 2: MVDC test infrastructure

- Voltage Range 400–4000 V
- DC 80 kA range / 3s @ 75 MW
- DC 5 kA / Continuous @ 4 MW



Mayr, J., Kupzog, F., Brauner, G. *et al.* Planung und Umsetzung einer Laborinfrastruktur für Gleichspannungs-Hochleistungs-Prüfungen. *Elektrotech. Inftech.* **139**, 449–457 (2022).

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Galway Pilot

University of Galway

Live, learn, lead…

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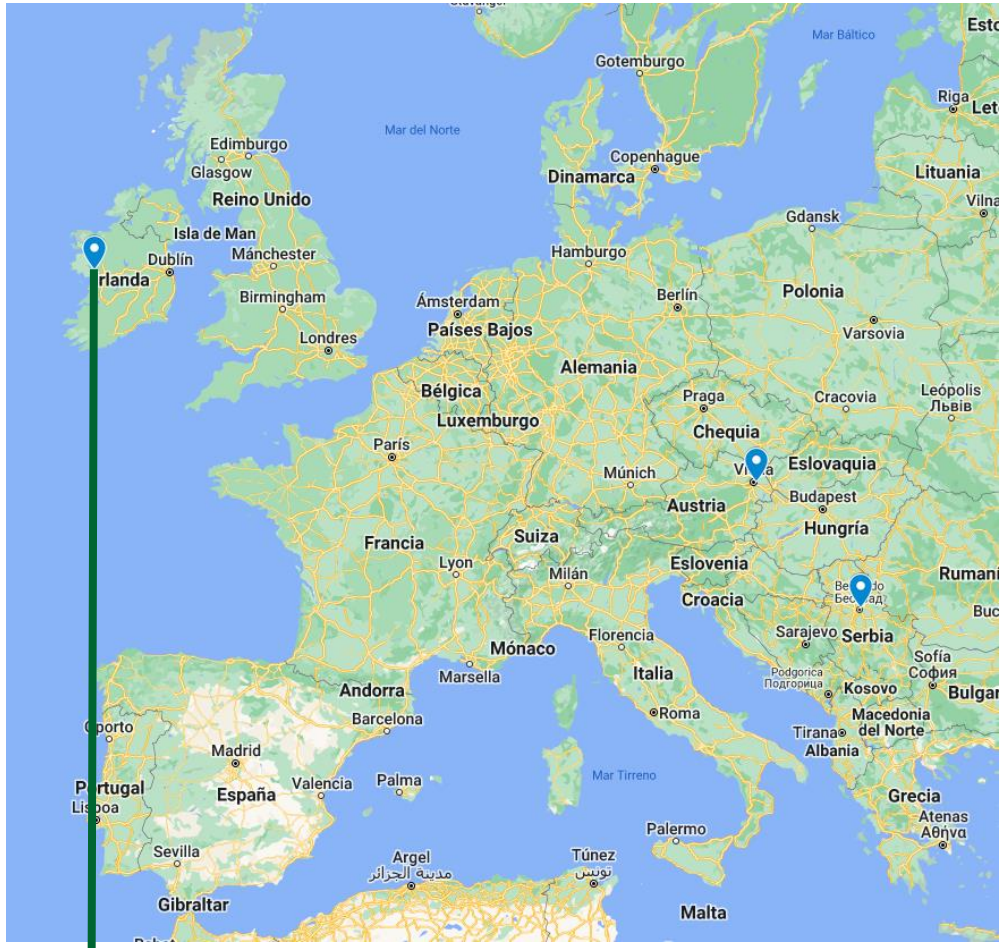

Ollscoil na Gaillimhe
University of Galway

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ALICE PERRY ENGINEERING BUILDING Living Laboratory Concept

https://youtu.be/kCoGKDgtVsw

20 WAYS THAT THE ENGINEERING BUILDING IS SUSTAINABLE

This list outlines just some of the sustainable initiatives implemented in the Engineering Building.

1. Metering of primary and secondary utility systems HVAC and Power systems;
2. 500kW thermal, 350kW electrical, natural gas-fired CHP;
3. 950kW pellet biomass boiler;
4. Three >95% per cent efficient natural gas condensing boilers;
5. Rainwater harvesting;
6. District heating system using waste heat from the NEB to feed swimming pool and the sports centre;
7. Low embodied energy materials (e.g. zinc), 40% GGBS based concrete and voided slab systems;
8. Ground-source heat pump in southern parkland;
9. Lux dipping throughout the day and night
10. Grass roof for water attenuation and insulation;
11. 75m³ rainwater harvesting tank (re-used for toilets);
12. Large buried water attenuation tank (to stop major discharge to the city sewers);
13. Heat exchangers (using the atrium as a building lung and passive vents in the laboratories);
14. Green, amber and red light signals in large postgraduate areas indicating, respectively, naturally ventilated or comfort cooled displacement ventilation environments;
15. Low energy lighting with presence and lux level lighting controls including manual switching;
16. LED exit signs and emergency lighting;
17. External LED lighting with time-clock and photocell control;
18. Metering of power systems;
19. Maximising free cooling by using displacement ventilation in the comfort-cooled lecture theatres;
20. Use of an emergency centre to reduce construction requirement, prevent overheating of plant areas, reduce noise and provide a teaching tool.

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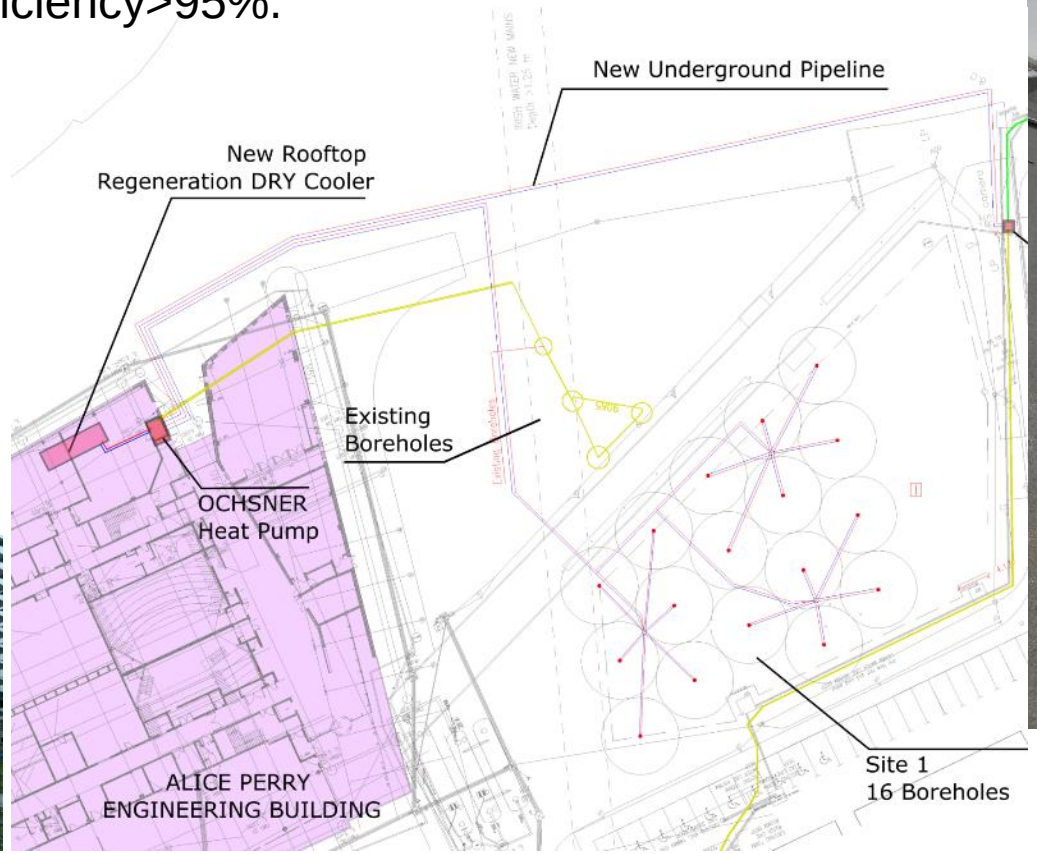
ALICE PERRY ENGINEERING BUILDING Energy Efficient Technologies Showcase

- Pellet biomass boiler 950kW
- Natural gas condensing boilers efficiency>95%.
- Recent Solar Photovoltaic
- Embedded Sensors
- Double Skin Façade
- Solar Thermal
- Rainwater Harvesting
- Geothermal Heat Pump Upgrade
- BMS Cylon with BMS Database



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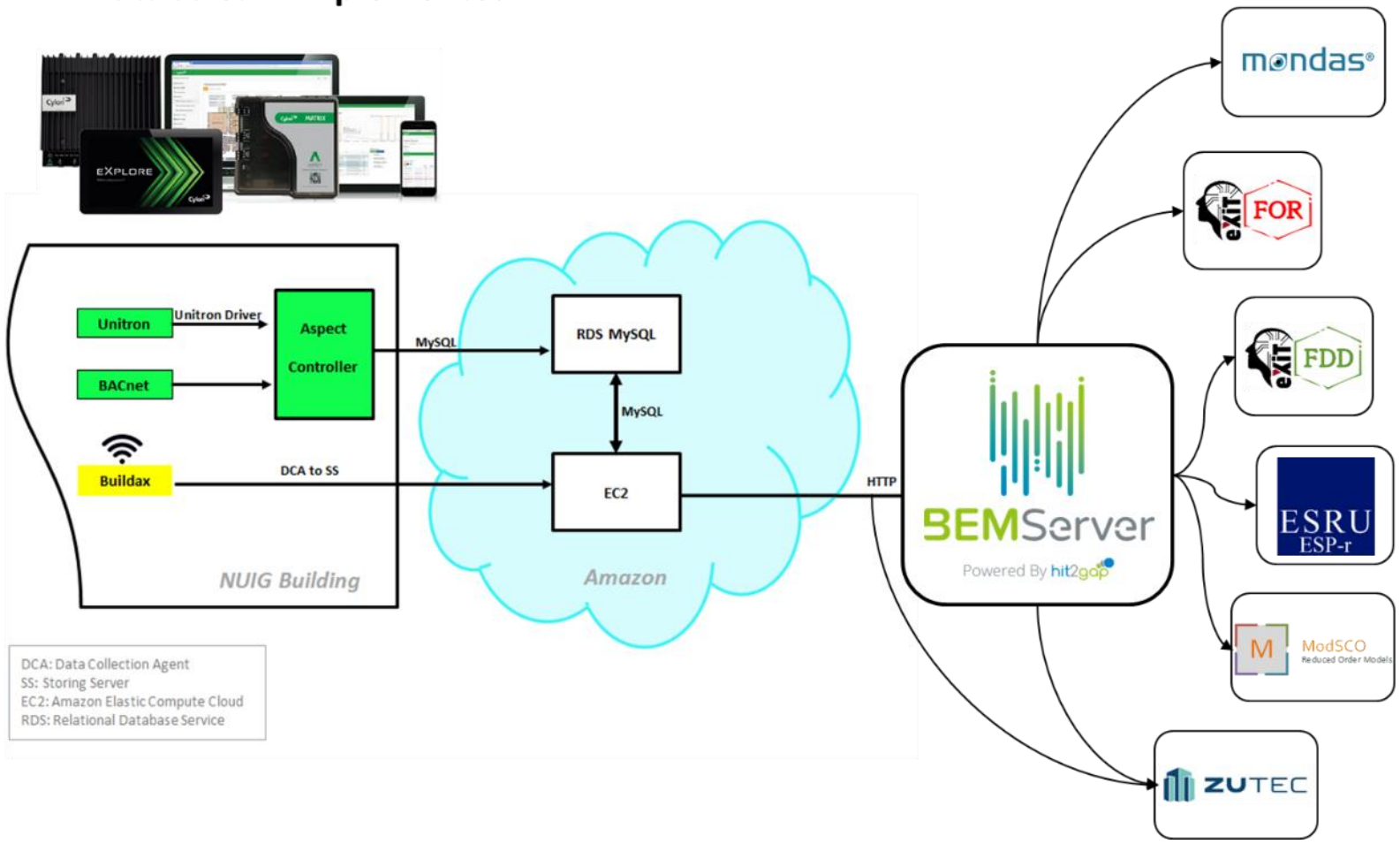
ALICE PERRY ENGINEERING BUILDING AS A RESEARCH TOOL

EXAMPLE of CROSS COLLABORATION / Industry / Universities

- Load forecasting by University of Girona
- Fault detection and Diagnosis by University of Girona
- PCA based Machine Learning by Fraunhofer ISE
- ESP-r by University of Strathclyde
- ModSCO by NUIG
- BIM visualisation by ZUTEC

Data stream implemented



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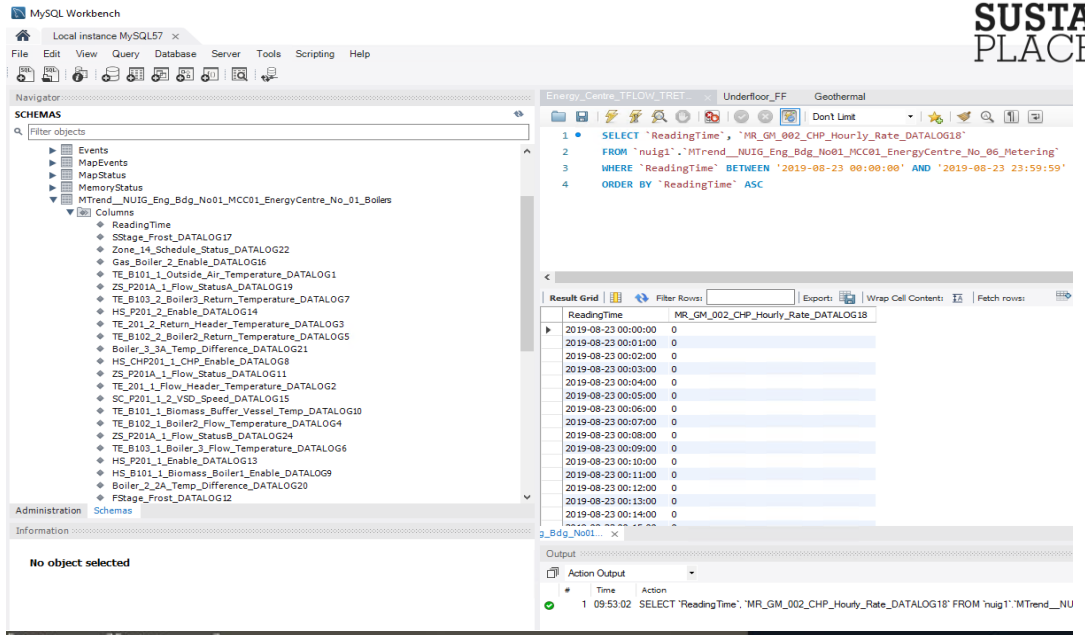
ALICE PERRY ENGINEERING BUILDING BMS DATABASE



LEGACY - MySQL Database

1,800 Endpoints

1 data minute resolution

Continuously storing data **to date**

Open access for research purposes

We want to hear your proposals!

Contact: luismiguel.blanesrestoy@nuigalway.ie

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ALICE PERRY ENGINEERING BUILDING DRONE FOOTAGE

https://www.youtube.com/watch?v=wNcyb4quV8Y

https://www.youtube.com/watch?v=BGZes2WXWtk

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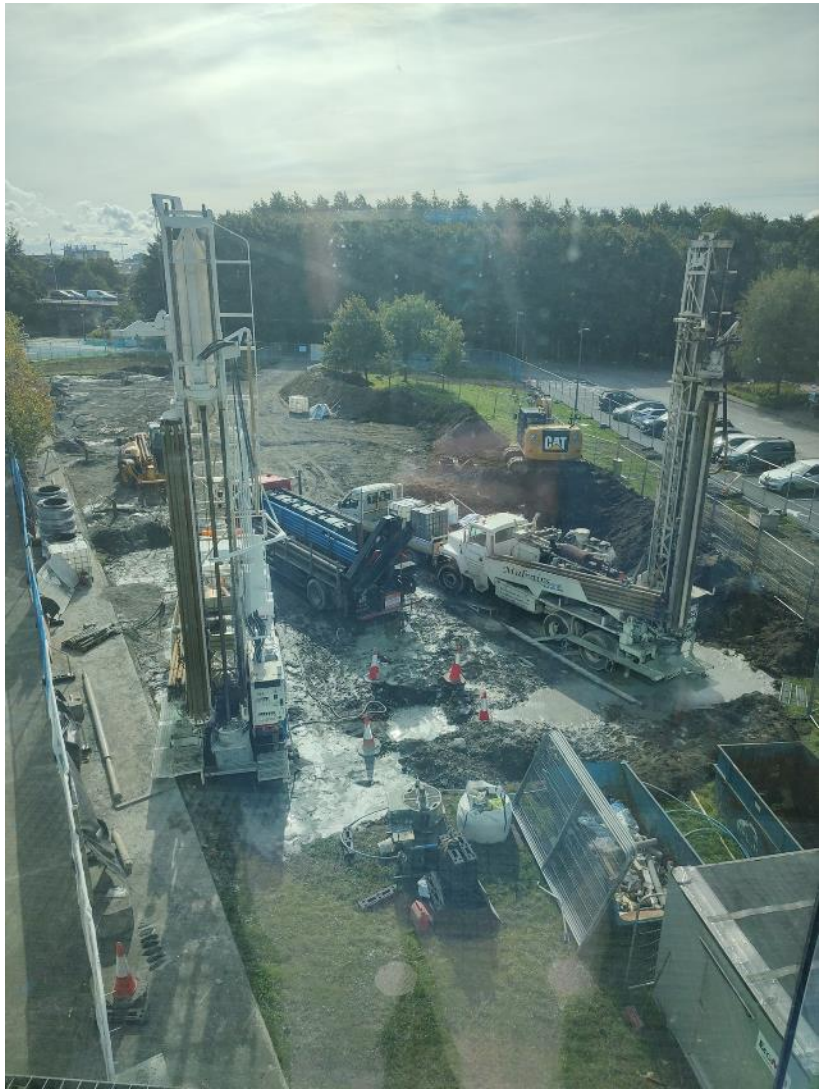
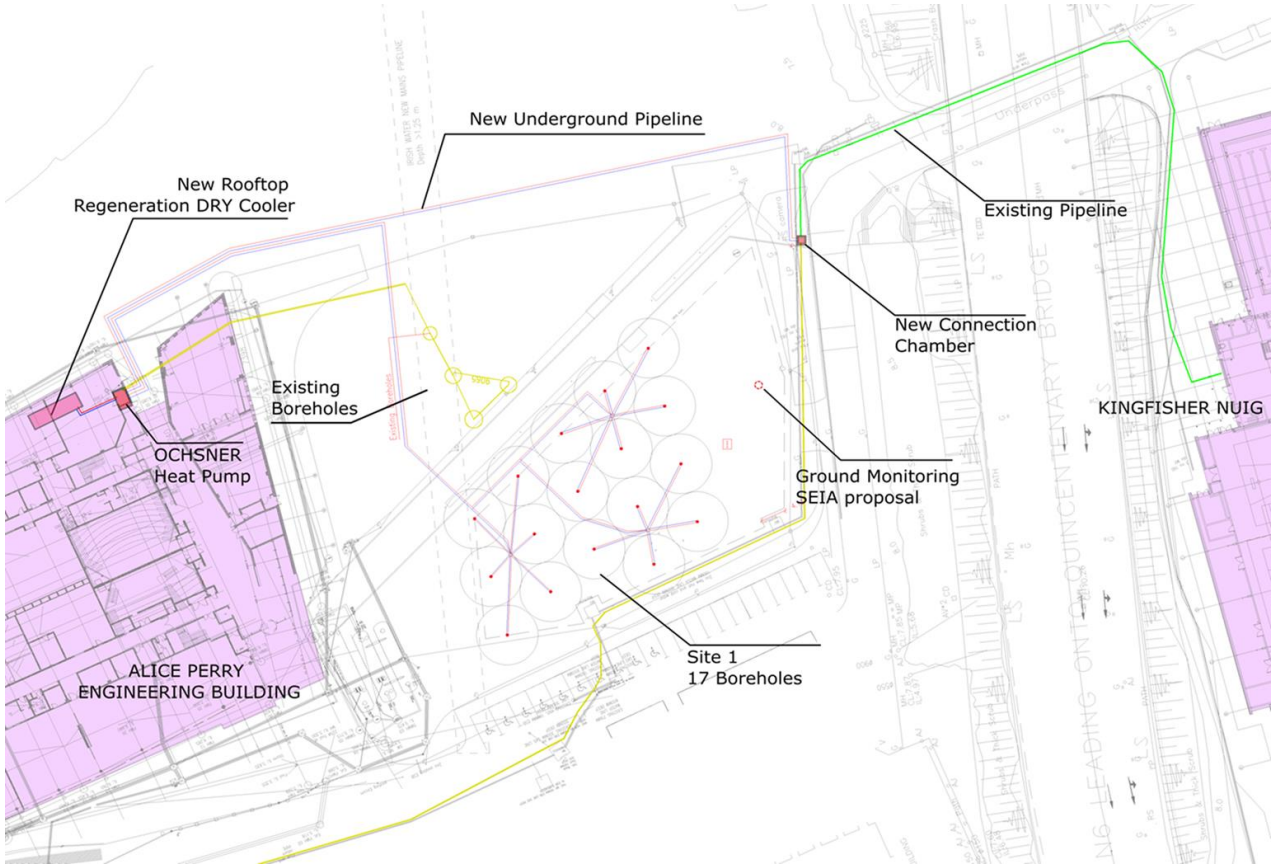
GEOFIT – Pilot assets - GSHP





- 18 boreholes – 150 m. depth
- Donwhole equipment
- District Heating pipeline

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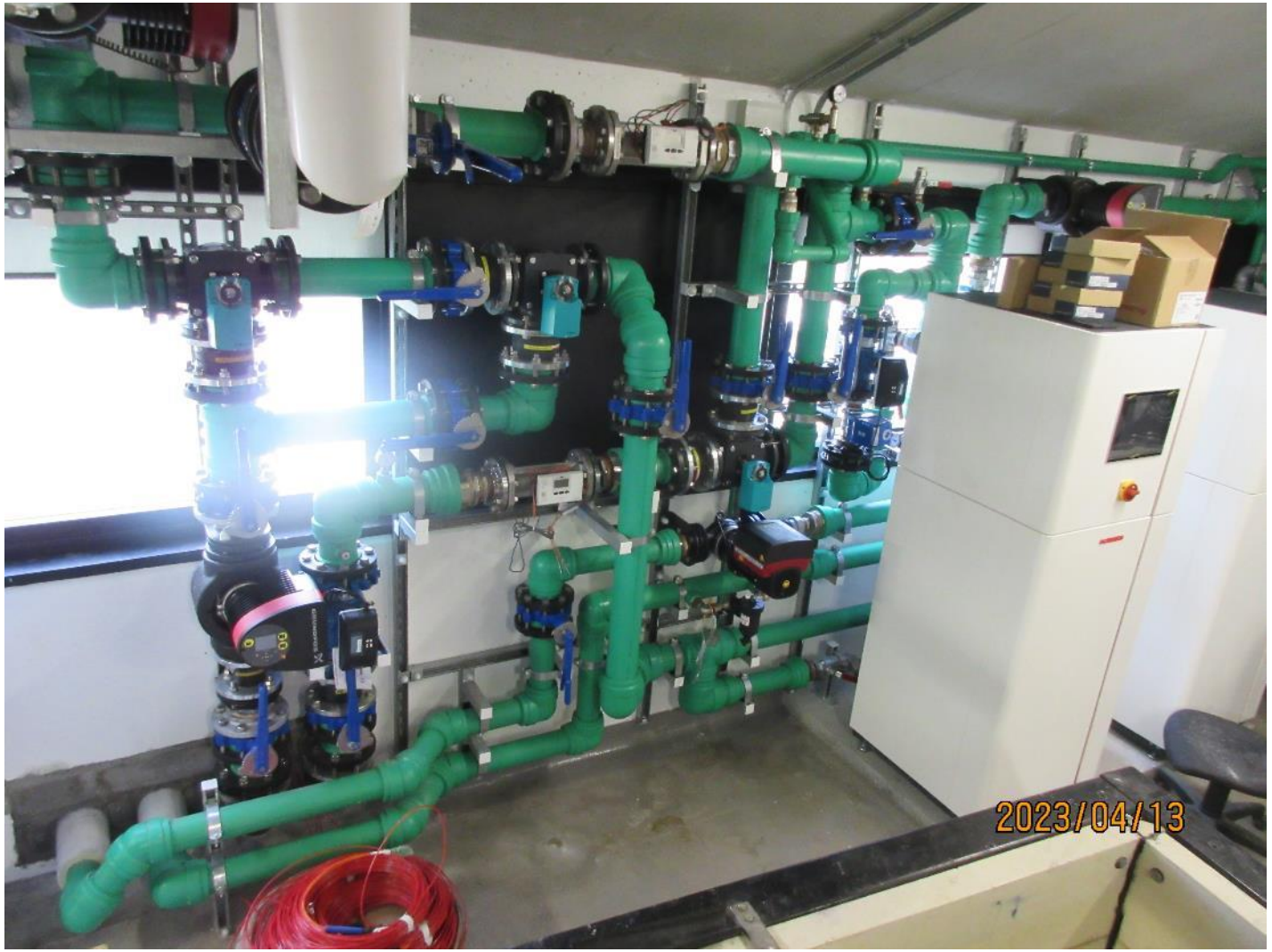
GEOFIT – Pilot assets



- Dual Source Air/Ground
- Cloud BEM service
- DTS system
- Long term drif ground temp.
- Heat metered according to IEA TCP-HPT ANNEX 52
- Independent database for storical data
- Teaching demonstrator
- Open for research

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SINERGY Conference – 2023

26-28 sept 2023 – Belgrade
Submit your extended abstract **here**

Sinergy
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Submitted by valentina.janev on Mon, 06/13/2022 - 13:42

International SINERGY Conference on Smart and Innovative eNERGY management, 26-28 September 2023

The European electricity system undergoes significant changes driven by the EU common rules for the internal market for electricity, as well as by the climate action agenda. With solar and wind power on the rise, grid operators need new equipment to make the whole power system operate flexibly. Hence novel sensors, advanced data exchange infrastructures, and data handling capabilities that make use of Big Data, Artificial Intelligence, 5G and distributed ledger technologies are needed to enhance forecasting, allow the remote monitoring and management of distributed generation and improve asset optimisation. Smart Energy Management refers to a variety of novel concepts and technologies, serving at both energy generation and consumption side, such as energy efficiency, demand management, Smart Grid, micro-grids, renewable energy sources (RES), and other emerging solutions. It represents one of the fastest developing fields, according to the EU priorities, while, at the same time, it remains somewhat neglected in the South-eastern Europe countries.

The SINERGY International Conference on Smart Energy Management technologies will be held in Belgrade, Serbia end of September 2023.

Specific topics covered by the conference program include, but are not limited to:

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Thank You for Your Attention !

https://project-sinergy.org/

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